

# SE 110.20

## Deformation of frames



The illustration shows SE 110.20 in the frame SE 112

### Description

- elastic deformation of a statically determinate or indeterminate frame under point load
- U-shaped and S-shaped frame
- principle of virtual work to calculate the deformation and support reaction in a statically indeterminate system

A frame is a bent beam with rigid corners which creates a so-called structure gauge. This means that it spans a gap while at the same time creating height.

SE 110.20 includes a typical U-shaped frame, such as is used in the construction of halls for example. One end is clamped into place, while the other can be loosely mounted. When the non-clamped end remains free, the statically determinate frame is investigated. A roller bearing on the non-clamped end creates a statically indeterminate frame. The frame is placed under load by weights. The load application points are movable. Two dial gauges record the deformations of the frame under load.

By applying various methods (first-order elasticity theory; the principle of superposition; and the principle of virtual work), the bending moment characteristics are ascertained for a statically determinate and indeterminate frame. From these characteristic curves and a chart for integrals (coupling table) the differential equation of the bend line is formulated. From the bend line and its derivations, displacements and the support force on the floating bearing can be calculated.

A second, S-shaped frame can be used to show that the various methods are applicable to any kind of frame. All the component elements of the experiment are clearly laid-out and housed securely in a storage system.

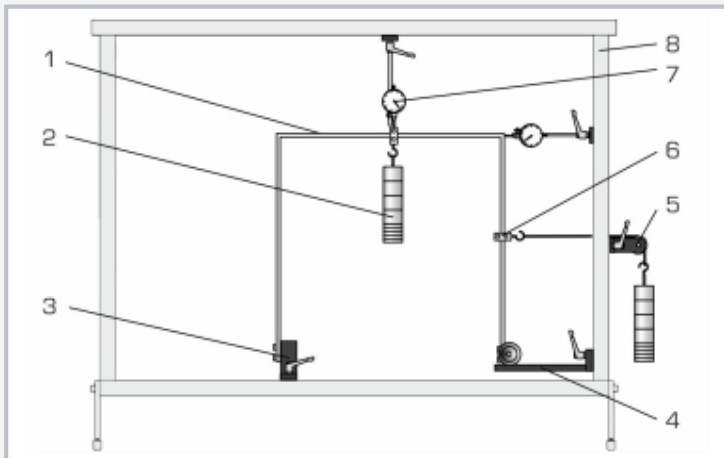
The complete experimental setup is arranged in the frame SE 112.

### Learning objectives/experiments

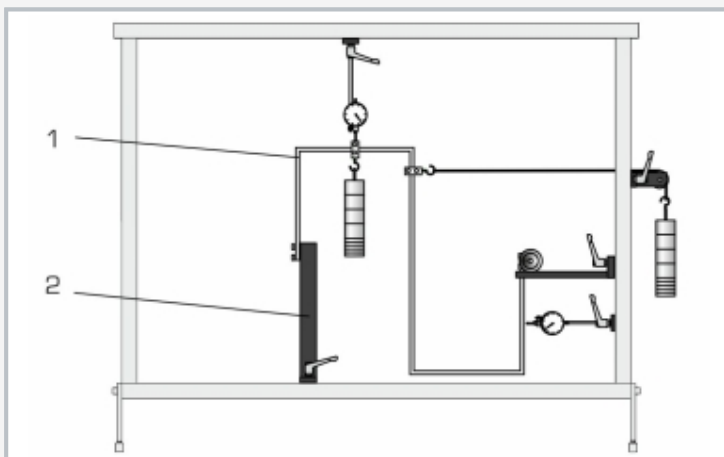
- relationship between load application and deformation on the frame
- differences between statically determinate and statically indeterminate frames
- familiarisation with the first-order elasticity theory for statically determinate and indeterminate systems
- application of the principle of superposition
- application of the principle of virtual work on statically determinate and statically indeterminate frames
  - ▶ determination of a deformation by the principle of virtual forces
  - ▶ determination of a load by the principle of virtual displacement
- comparison of calculated and measured deformations

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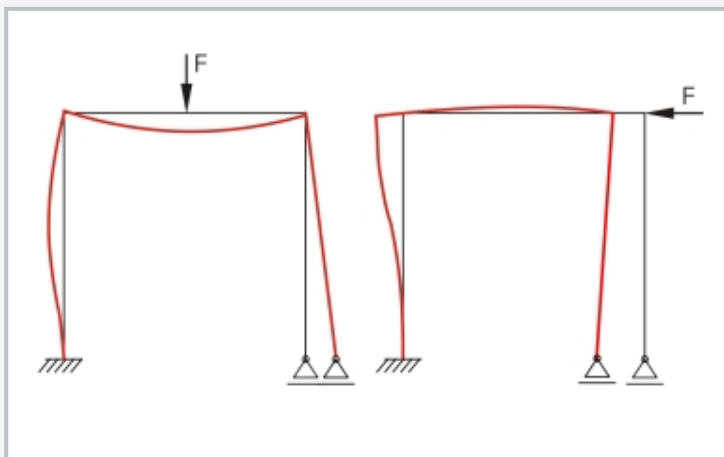
## Deformation of frames



1 U-shaped frame, 2 weight, 3 short clamping pillar, 4 roller bearing, 5 deflection roller with fixture, 6 movable hook, 7 dial gauge, 8 frame SE 112



1 S-shaped frame, 2 long clamping pillar



Example deformations of the statically indeterminate frame under load:  
red: deformed frame; black: frame under no load

### Specification

- [1] investigation of the deformation of steel frames under load
- [2] 1 U-shaped and 1 S-shaped frame
- [3] statically determinate or statically indeterminate bearing support possible
- [4] 1 long and 1 short clamping pillar
- [5] roller bearing for statically indeterminate support
- [6] weights with a movable hook to adjust to any load application point
- [7] dial gauges record the deformation of the investigated frame under load
- [8] storage system to house the components
- [9] experimental setup in frame SE 112

### Technical data

- Frame made of steel
- edge length: 600mm
  - cross-section: 20x10mm
  - U-shaped: 600x600mm
  - S-shaped: 600x600mm

- Dial gauges
- measuring range: 0..20mm
  - graduation: 0,01mm

- Weights
- 2x 1N (hanger)
  - 8x 1N
  - 6x 5N

LxWxH: 1170x480x178mm (storage system)  
Weight: approx. 34kg (total)

### Required for operation

Mounting frame SE 112

### Scope of delivery

- 2 frames (1x U-shaped, 1x S-shaped)
- 2 clamping pillars (1x long, 1x short)
- 1 bearing
- 1 set of weights with movable hooks
- 1 deflection roller with fixture
- 1 cable
- 2 dial gauges with bracket
- 1 storage system with foam inlay
- 1 set of instructional material

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Required accessories

022.11200      SE 112      Mounting frame